



Study of Pest Inventory and Disease Control in Organic-Based Food Crops at the Land Suitability Level in the Medium Plains Area in the Dry Land of North Central Timor Regency

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Abstract: Conventional farming is a farming system still commonly used in Indonesia. Organic pesticides are pest and disease control products made from organic materials. This trend aligns with increasing public awareness of health and environmental sustainability issues. However, the success of organic farming is highly dependent on the ability of farmers to manage environmental factors, including the threat of Plant Pest Organisms (OPT), namely pests and diseases, without using chemicals. This study aims to inventory in detail the main pest and disease species in organic food crops in the middle plains of dry land TTU, analyze the correlation between the level of OPT attacks with the level of land suitability and formulate adaptive and site-specific organic control strategies, based on the inventory findings. This study was conducted in Lapeom Village, Insana Barat District, North Central Timor Regency. This study used active collection methods (browsing method) and passive (trap method). Active collection by direct collection using insect nets (sweep net) and direct collection using hands (hand picking and direct observation), while in passive collection using insect traps consisting of yellow traps, methyl eugenol attractants and pitfall traps using 5 pest control methods, namely yellow traps, methyl eugenol attractants, pitfall traps, sweep nets and hand picking and direct observation. The results of the study showed that there were 8 orders and 22 families of insect pests from 5 observation methods, namely: Pitfall trap, Yellow trap, Sweep net, Attractant and Hand picking and direct observation: Insect pests consist of: order Blattodea (family Ectobiidae), order Coleoptera (family Chrysomelidae), order Diptera (family Tephritidae, family Muscidae, family Bibionidae, family Calliphoridae), order Hemiptera (family Cicadellidae, family Alydidae), order Lepidoptera (family Erebidae, family Crambidae), order Orthoptera (family Gryllidae, family Gryllotalpidae, family Tettigoniidae).

Keywords: Biological Control; Disease Control; Dry Land; Insect Pests

Introduction

Conventional farming is a farming system still commonly practiced in Indonesia (Herdiansyah et al., 2023; Sukristiyonubowo et al., 2011). This agricultural system relies heavily on inorganic inputs such as fertilizers and pesticides (Achmad et al., 2022; Aziz et al., 2016). Continuous, high-dose use can cause environmental and ecological damage. This contradicts the Sustainable Development Goals (SDGs) agenda, which is part of the global development agreement. One

of these is SDG 12, which focuses on supporting food security, particularly sustainable production and consumption (Chan et al., 2018; Mensah et al., 2024; Shaikh et al., 2024; Sylvester, 2024).

The SDGs can be achieved in the agricultural sector if people begin to shift from conventional to sustainable agriculture (Campagnolla et al., 2019). One application of sustainable agriculture in controlling pests and diseases in cultivated plants is the use of environmentally friendly pesticides. Organic pesticides are pest and disease control products made from organic

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materials (Ansari & Khan, 2024; Duarte-Casar et al., 2025; Kalkura et al., 2021). Botanical pesticides are a biological pest and disease control technique that utilizes plants containing secondary metabolites that can have a negative effect on pests (Damalas & Koutroubas, 2020; Dubey et al., 2008; Ngegba et al., 2022).

Organic farming systems are increasingly gaining global attention as an alternative for producing safe and sustainable food crops, free from pesticide residues and synthetic chemical fertilizers. This trend aligns with increasing public awareness of health and environmental sustainability issues. However, the success of organic farming is highly dependent on the ability of farmers to manage environmental factors, including the threat of Plant Pest Organisms (OPT), namely pests and diseases, without using chemicals (Budi, 2021).

Method

This research used active (browsing) and passive (trapping) collection methods. Active collection involved direct collection using a sweep net and direct collection by hand (hand picking and direct observation). Passive collection involved insect traps consisting of yellow traps, methyl eugenol attractants, and pitfall traps (Ghosh & Markad, 2023; Mangang et al., 2025).

Observations of the sites to be used for research aimed to gather information on the research sites on food crop farms, including corn, rice, chilies, green beans, long beans, and carrots. They also examined field conditions, including land area, plant age, pesticide and fertilizer history, and types of insect pests and diseases affecting the crops.

Determination of sample plants was carried out directly at local crop farms, including corn, rice, chilies, green beans, long beans, and carrots. Observations were conducted in the morning from 7:00 AM to 10:00 AM and in the afternoon from 3:00 PM to 5:00 PM WITA (Central Indonesian Time) in designated plots, twice a week.

Insect sampling was conducted using three traps: pitfall traps, yellow traps, and methyl eugenol attractants (Khater et al., 2026). Insect sampling was conducted directly using sweep nets, hand picking, and direct observation at the observation locations (Noyes, 1989).

Sweep Net Method

Sweep nets are used to collect insects that are active in the morning, afternoon, and evening, such as grasshoppers, butterflies, and bees. These traps are set by swinging a sweep net around the plantation area. The

collected insects are killed by placing them in insect bottles containing ethanol. Pest sampling was conducted once a week for two weeks, in the morning from 7:00 AM to 10:00 AM and in the afternoon from 3:00 PM to 5:00 PM WITA. A total of two sampling sessions were conducted.

Pitfall Trap Method

Pitfall traps are used to collect active insects above ground (Brown & Matthews, 2016). They use plastic containers, such as Aqua cups, submerged in the soil filled with water mixed with a mixture of slurry, detergent, and sugar until the surface is level with the soil. Traps are set in the morning between 7:00 and 10:00 a.m. WITA (Central Indonesian Time). Pest sampling is conducted two days after the trap is set and once a week for two weeks after the trap is set. A total of two sampling sessions are conducted.

Yellow Trap Method

The yellow trap method is used to trap insect pests in aboveground areas and insects attracted by the color yellow (Zulkifli et al., 2024), using yellow insect glue. Traps are set in the morning between 7:00 and 10:00 a.m. WITA (Central Indonesian Time). Pest sampling is conducted two days after the trap is set, and once a week for two weeks after the trap is set. A total of two sampling sessions are conducted.

Methyl eugenol attractant method

Methyl eugenol traps are made by cutting the left and right sides of used mineral water bottles, then inserting a wire hanger inside for the cotton used as an attractant (Akter et al., 2021; Singh & Bajaj, 2022). The traps are placed by hanging them from tree branches at a height of 1.5 meters above the ground. Traps are set in the morning around 7:00-8:00 AM WITA. Fruit fly sampling in the field is carried out once a week on alternating days for two weeks, resulting in a total of two sampling sessions.

Hand-picking and direct observation method

The hand-picking and direct observation method involves picking and collecting insects directly by hand during direct observation without using traps in the agricultural field (Ishaya et al., 2018). Collection is carried out once a week for two weeks, in the morning from 7:00-10:00 AM and in the afternoon from 3:00-5:00 PM WITA. This results in a total of two sampling sessions.

Identification of Insect Pests

Insect pests caught in the traps were collected and placed in insect bottles filled with ethanol. Afterward, the insect pests were collected and identified.

Identification was carried out using the insect identification key and the sixth edition of the introduction to insect studies (Triplehorn & Johnson, 2005).

Result and Discussion

Insects found at the research site in Lapeom Village, West Insana District, North Central Timor Regency
Insect diversity collected from pitfall traps at the site

Based on Table 1, the insects obtained from each observation plot using pitfall traps at that location are insects from the Blattodea order consisting of 1 family, namely the Ectobiidae family with a total of 44 individuals, the Coleoptera order consisting of 2

families, namely the Coccinellidae family with a total of 13 individuals, the Carabidae family with a total of 41 individuals, the Diptera order consisting of 2 families, namely the Tachinidae family with a total of 11 individuals, the Muscidae family with a total of 7 individuals, the Hymenoptera order consisting of 1 family, namely the Formicidae family with a total of 1 individual, and the Orthoptera order consisting of 4 families, namely the Gryllidae family with a total of 37 individuals, the Gryllotalpidae family with a total of 2 individuals, the Tetrigidae family with a total of 9 individuals, and the Tettigoniidae family with a total of 2 individuals. 3.1.2 Insect diversity obtained from Yellow Traps at the location.

Table 1. Insect species collected from pitfall traps at the research site

Ordo	Families	Types of Pitfall Trap								Total
		Plot					Repeat			
		1	2	3	4	5	1	2		
Blattodea	Ectobiidae	6	7	5	6	7	9	4	44	
Coleoptera	Coccinellidae	2	1	3	1	2	4	-	13	
	Carabidae	7	-	9	6	6	2	11	41	
Diptera	Tachinidae	3	-	3	1	2	2	-	11	
	Muscidae	-	4	1	-	-	2	-	7	
Hymenoptera	Formicidae	-	-	-	-	1	-	-	1	
Orthoptera	Gryllidae	10	8	6	3	7	1	2	37	
	Gryllotalpidae	-	2	-	-	-	-	-	2	
	Tetrigidae	1	3	3	3	2	-	-	9	
	Tettigoniidae	-	-	-	-	-	-	2	2	
Total									167	

Based on Table 2, the insects collected from each observation plot using Yellow Traps at the research site were insects from the order Coleoptera, consisting of one family, the Coccinellidae family, with 30 individuals, and the order Diptera, consisting of two families, the Tephritidae family with 48 individuals and the Muscidae family with 2 individuals.

Insect Diversity Obtained from the Sweep Net Method at the Site

Based on Table 3, the insects obtained from each plot using the sweep net method at the research site were insects from the order Coleoptera, consisting of one family, the Coccinellidae family, with 7 individuals; the

order Lepidoptera, consisting of three families: the Erebidae family with one individual; the Crambidae family with three individuals; the Pieridae family with three individuals; and the order Orthoptera, consisting of one family, the Tettigoniidae family with one individual.

Diversity of insects obtained using the methyl eugenol attractant method at the research site

Based on Table 4, the insects collected from each observation plot using methyl eugenol attractant traps at the research site were from the order Diptera, consisting of one family, the Tiphytiridae, with a total of 34 individuals.

Table 2. Types of insects obtained from Yellow Traps at the research location

Ordo	Families	Types of Yellow Trap								Total
		Plot					Repeat			
		1	2	3	4	5	1	2		
Coleoptera	Coccinellidae	4	5	9	1	4	1	6	30	
Diptera	Tephritidae	8	6	5	7	7	9	6	48	
	Muscidae	1	-	-	1	-	-	-	2	
Total									80	

Table 3. Types of Insects Collected from Sweep Nets at the Research Site

Ordo	Families	Types of method <i>Sweep net</i>						Total
		Plot 1		Plot 2		Plot 3		
		1	2	1	2	1	2	
Coleoptera	Coccinellidae	1	-	3	-	2	1	7
Lepidoptera	Erebidae	-	1	-	-	-	-	1
	Crambidae	-	1	1	-	1	-	3
	Pieridae	1	-	-	1	1	-	3
Orthoptera	Tettigoniidae	-	-	-	-	-	1	1
Total			4		5		6	15

Table 4. Types of insects obtained using the methyl eugenol attractant at the research site

Ordo	Families	Types of method <i>atraktan metyl eugenol</i>						Total
		Plot 1		Plot 2		Plot 3		
		1	2	1	2	1	2	
Diptera	Tephtiritidae	17	3	3	8	2	1	34
Amount			20		11		3	34

Insect diversity obtained from hand-picking and direct observation methods at the research site

Based on Table 5, the insects collected from each plot using hand-picking and direct observation methods at the research site were insects from the order Coleoptera, which consists of three families: the

Coccinellidae family with 15 individuals, the Silphidae family with 2 individuals, the Chrysomelidae family with 1 individual, the Hemiptera order with 2 families: the Reduviidae family with 1 individual, the Alydidae family with 1 individual, and the Mantodea order with 1 family, the Mantidea family with 3 individuals.

Table 5. Insect species obtained from hand-picking and direct observation methods at the research site

Ordo	Families	<i>Hand picking and direct observation</i>															Total
		Plot					Plot					Plot					
		Repeat					Repeat					Repeat					
		1	2	4	5	1	2	3	4	5	1	2	3	4	5		
Coleoptera	Coccinellidae	-	1	2	1	2	-	-	3	-	1	-	1	-	-	4	15
	Silphidae	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	2
	Chrysomelidae	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Hemiptera	Reduviidae	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
	Alydidae	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
Mantodea	Mantidae	-	-	-	-	-	-	1	-	-	1	-	-	-	1	-	3
Amount				6				10					7				23
Total																	

Classification and Morphological Characteristics of Insects Collected from the Research Site in Lapeom Village, West Insana District, North Central Timor Regency

Tachinidae Family

The general classification of the Tachinidae family according to Triplehorn & Johnson (2005) as follows: Kingdom: Animalia; Phylum: Arthropoda; Class: Insecta; Order: Diptera; and Family: Tachinidae.

The Tachinidae family has the following characteristics: They are generally blackish-gray in color, only 5-10 millimeters long, and are typically thickly hairy and similar to houseflies. The abdomen of tachinid flies usually has a number of very large hairs, except for the smaller ones. They have a wide variety of shapes and colors. They feed on flower pollen (Triplehorn & Johnson, 2005).

Ectobiidae Family

The general classification of the Ectobiidae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: blattodea; and family: ectobiidae.



Figure 1. Tachinidae family: (a) Observation results; (b) Comparative images from the literature

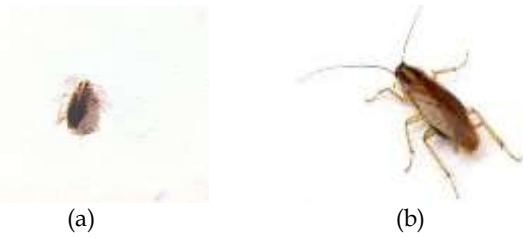


Figure 2. Ectobiidae family: (a) Observation results; (b) Comparative images from the literature

The Ectobiidae family has the following characteristics: adults measure approximately 1.1 to 1.6 cm, their color varies from light brown to almost black. Nymphs (young cockroaches) are darker, ranging from dark brown to black. They have two dark, parallel stripes on the pronotum that extend from the back of the head to the base of the wings. Nymphs have a single pale stripe down the middle of their bodies. Although they have wings, they rarely fly and often glide when disturbed. Their bodies are oval and flat, their legs are spiny, and their antennae are long (Triplehorn & Johnson, 2005).

Carabidae Family

The general classification of the Carabidae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: coleoptera; family: carabidae.



Figure 3. Carabidae family: (a) Observation results; (b) Comparative images from the literature

The Carabidae family has the following characteristics: a body length of 7 mm, a glossy brownish-black color, three pairs of legs, one pair of antennae, 2 mm long and consisting of 11 segments, a thorax larger than the head, a distinct septum between the head and thorax, and elytra between the abdominal clefts. This family varies in body shape, size, and color. However, most members of the Carabidae family are dark and glossy and have filiform (thread-like) antennae. They are generally found in rocky areas and burrows (Triplehorn & Johnson, 2005).

Gryllidae Family

The general classification of the Gryllidae family according to Triplehorn & Johnson (2005) is as follows.

Kingdom: animalia; phylum: arthropoda; class: insecta; order: orthoptera; and family: gryllidae



Figure 4. Gryllidae family: (a) Observation results; (b) Comparative images from the literature

The Gryllidae family has the following characteristics: one pair of fine, hair-like antennae and a long ovipositor. They have long antennae, needle-like or cylindrical egg-laying organs, forewings that curve downwards sharply on the sides of the body, a smooth, hairless thorax, three pairs of legs (the femurs of the hind legs are large), and one pair of appendages on the abdomen (Triplehorn & Johnson, 2005).

Coccinellidae Family

The general classification of the Coccinellidae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: coleoptera; and family: coccinellidae.

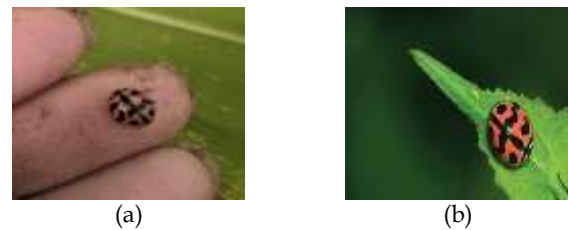


Figure 5. Coccinellidae family: (a) Observation results; (b) Comparative images from the literature

The Coccinellidae family has the following characteristics: a broad, oval-shaped body, a head entirely or partially hidden under the pronotum, short antennae with 3-6 segments, and three pairs of legs. The Coccinellidae family is bright yellow, orange, or red with black or black to red spots. The anterior corner is yellow. The wings are yellow-brown with black bands. Each wing has two pairs of large bands and a black median stripe. The anterior and posterior sides of the median stripe have a single, rather large black spot (Triplehorn & Johnson, 2005).

Formicidae Family

The general classification of the Formicidae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: hymenoptera; and family: formicidae



Figure 6. Formicidae Family: (a) Observation results; (b) Comparative images from the literature

The Formicidae family has the following characteristics: the body is divided into three main sections: the head, mesosoma (thorax), and metasoma (abdomen). A distinctive feature of the Formicidae is the presence of a stalk (pedicel) on the metasoma, which has one or two segments and contains an upward-pointing wattle (protrusion) (Triplehorn & Johnson, 2005). Ants are a group of animals that, based on their biological and ecological characteristics, play an important role as predators, decomposers, and herbivores in an ecosystem.

Muscidae Family

The general classification of the Muscidae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: diptera; and family: muscidae



Figure 7. Muscidae family: (a) Observation results; (b) Comparative images from the literature

The Muscidae family has the following morphological characteristics: black or greenish body color, hairs around the abdomen, ovoid wings, and lines on the wing venation. The wings of these insects consist of a third medium frame and a medium longitudinal transverse frame. The legs have fine hairs. The Muscidae family is a group of insects that closely resembles houseflies. This type of pest fly breeds in feces (Triplehorn & Johnson, 2005).

Tephritidae Family

The general classification of the Tephritidae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: diptera; and family: tephritidae.



Figure 8. Tephritidae family: (a) Observation results; (b) Comparative images from the literature

The Tephritidae family has the following characteristics: three body parts: the head (caput), chest (thorax), and abdomen. Fruit flies also have three pairs of legs that emerge from the thoracic segments. Fruit flies have two wings, the developed forewings being the front wings and the reduced hind wings, which also serve as a means of balance. The fruit fly's head is slightly oval, where its three-segmented antennae are attached. The antennal segments are brownish-yellow, and the body is yellow. There is also a black median stripe. The Tephritidae family are small insects that generally attack plant fruit (Triplehorn & Johnson, 2005).

Tettigoniidae Family

The general classification of the Tettigoniidae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: diptera; family: tettigoniidae.



Figure 9. Tettigoniidae family: (a) Observation results; (b) Comparative images from the literature

The Tettigoniidae family has the following characteristics: Generally green, although some have reddish colors, have antennae that are longer than their bodies, tarsi (the last part of the legs) consist of four segments, on the chest (thorax) there are three pairs of legs, each thoracic segment has a pair of legs, legs consist of coxa, trochanter, femur (which is large and long), tibia, and tarsus, have two pairs of wings, the front wings are long, narrow, and thick (tegmina), while the rear wings are thin and wide with many frames, short pronotum that does not cover both the abdomen and wings, the egg-laying tool (ovipositor) in females is green at the base, red in the middle, and black at the tip. The body length of the female imago is around 9.5-10.5 cm, with a 3-4.5 cm ovipositor and 16 cm antenna. The

male imago is 6-9.5 cm long (Triplehorn & Johnson, 2005).

Bibionidae Family

The general classification of the Bibionidae Family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: diptera; and family: bibionidae.



Figure 10. Bibionidae family: (a) Observation results; (b) Comparative images from the literature

The Bibionidae family has the following characteristics: Small to medium-sized swamp flies, usually dark in color, with hairs and a short chin that appears on the face. Many have a red or yellow thorax, often with black spots on the wings. Adults appear primarily in spring and early summer. Larvae live in decaying organic matter and among plant roots (Triplehorn & Johnson, 2005).

Calliphoridae Family

The general classification of the Calliphoridae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: diptera; and family: calliphoridae.

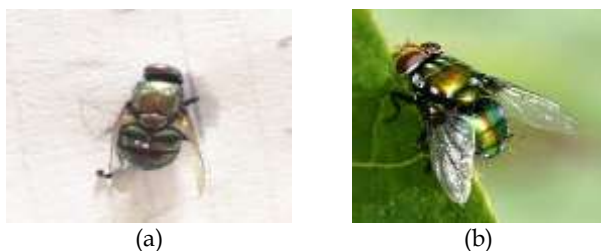


Figure 11. Calliphoridae Family: (a) Observation results; (b) Comparative images from the literature

The Calliphoridae family has the following characteristics: Adult flies are metallic green or blue with a yellow facial region, while the larvae tend to be smooth and lack distinct body protrusions except on the last segment. They have a relatively large head with two compound eyes that meet in the midline (holoptic) or are separated by a facial chamber (dichoptic), three ocelli or simple eyes, a segmented body with each body part clearly separated, paired limbs with symmetrical right and left halves, three separate body parts: the head,

thorax, and abdomen, and a pair of antennae (antennae), three pairs of legs and one pair of wings (Triplehorn & Johnson, 2005).

Erebidae Family

The general classification of the Erebidae Family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: lepidoptera; and family: erebidae.



Figure 12. Erebidae Family: (a) Observation results; (b) Comparative images from the literature

The Erebidae family has the following characteristics: Adult moths are black with a yellow or orange band on the abdomen, have transparent windows on their wings, and a wingspan of between 9 and 37 mm. These moths camouflage themselves like stinging wasps to protect themselves from predators such as birds. The moth's body consists of a head, thorax, and abdomen. The head contains the visual organs, mouthparts, sensory organs, compound eyes, and ocelli. The thorax houses the locomotory organs such as the wings and legs. The front wings are called forewings and the rear wings are called hindwings. The abdomen has eleven segments, generally covered with fine hairs, and contains vital organs such as the heart, reproductive organs, and most of the digestive system (Triplehorn & Johnson, 2005).

Gryllotalpidae Family

General classification of the Gryllotalpidae Family according to Triplehorn & Johnson (2005) as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: orthoptera; and family: gryllotalpidae.



Figure 13. Gryllotalpidae family: (a) Observation results; (b) Comparative images from the literature

The Gryllotalpidae family has the following characteristics: Mole beetles are insects characterized by a pair of modified front legs resembling serrated hoes used for digging and swimming. They have a large, hard-shelled head and a pair of small wings. Their body color varies from brownish to black, with a body length of between 27 and 35 mm. They are active at night or nocturnal (Triplehorn & Johnson, 2005).

Tetrigidae Family

The general classification of the Tetrigidae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: orthoptera; and family: tetrigidae.

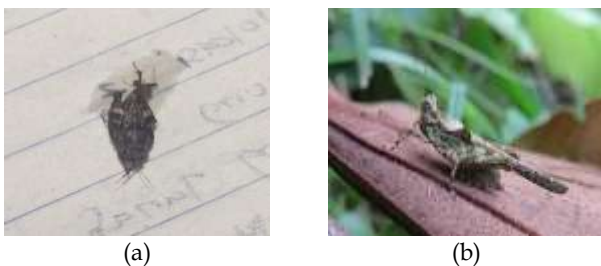


Figure 14. Tetrigidae family: (a) Observation results; (b) Comparative images from the literature

The Tetrigidae family has the following characteristics: The pronotum is elongated and tapered, may cover the wings (if present) and extend beyond the tip of the abdomen. The pronotum resembles a cushion and is sometimes absent, possibly exposed or covered by the anterior pronotum. It measures less than 20 mm in length, or about 6-16 mm in body length. The body size is approximately 13-19 mm in females. The middle tarsi have two segments, while the hind tarsi have three segments. Individual species may have short wings, long wings, or be wingless (Triplehorn & Johnson, 2005).

Pieridae Family

The general classification of the Pieridae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: lepidoptera; and family: pieridae.



Figure 15. Pieridae family: (a) Observation results; (b) Comparative images from the literature

The Pieridae family has the following characteristics: Small to medium-sized, with a wingspan of approximately 25–100 mm. The forewings are approximately 22–35 mm long. They are generally white or yellow, often with black spots on the wing margins. The white, yellow, and red pigments are produced by uric acid derivatives. They lack tails on their wings. They have three pairs of legs, with clawed or forked tips. Their forelegs are well-developed and have bifurcated claws. Their wings have a variety of bright colors, making them more striking. Male Pieridae butterflies often have more beautiful wings than females (Triplehorn & Johnson, 2005).

Crambidae Family

The general classification of the Crambidae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: lepidoptera; and family: crambidae.



Figure 16. Crambidae Family: (a) Observation results; (b) Comparative images from the literature

The Crambidae family has the following characteristics: Crambidae are somewhat variable in appearance. The nominal subfamily Crambidae (grass moths) has a posture resembling a folded blade of grass, while other subfamilies include brightly colored insects with patterns spread out on their wings. In many classifications, Crambidae is considered a subfamily of Pyralidae, or snout moths. The main difference is the intra-ear structure called the praecinctorium, which connects the two ear membranes in Crambidae, which is absent in Pyralidae. Their wings are covered with feathers or scales, they have two pairs of wings, the hind wings are generally smaller than the forewings, and their body size is small (Triplehorn & Johnson, 2005).

Cicadellidae Family

The general classification of the Cicadellidae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: hemiptera; and family: cicadellidae.



Figure 17. Cicadellidae Family: (a) Observation results; (b) Comparative images from the literature

The Cicadellidae family has the following characteristics: In general, identification of Hemiptera species (including leafhoppers) can be done by observing their morphology, which is divided into three main parts: the head (cephalus), the thorax (thorax), and the abdomen (abdomen). The head (cephalus), the nervous system, is located in the head and contains the eyes, mouthparts, and antennae. Green leafhoppers have small bodies, approximately 5 mm long, and are greenish-gray or brown in color. Species of the Cicadellidae family have a single cuneiform, four segments on the antennae, and a proboscis. They lack a single eye and have a soft body. The hind legs of leafhoppers tend to be modified for jumping (Triplehorn & Johnson, 2005).

Silphidae Family

The general classification of the Silphidae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: coleoptera; and family: silphidae.



Figure 18. Silphidae Family: (a) Observation results; (b) Comparative images from the literature

The Silphidae family has the following characteristics: oval-shaped, 2-4 cm long, glossy black with two large reddish-orange spots on each elytra; the prothorax is semicircular and red; the head is almost as large as the prothorax.

Burying beetles help keep the earth's surface clean by burying dead small animals. When a pair of these beetles finds the carcass of a dead mouse or small snake, the female lays her eggs inside the carcass. The beetles then bury the carcass 7-10 cm deep in the soil. After the

larvae hatch, they feed on the carcass (Triplehorn & Johnson, 2005).

Chrysomelidae Family

The general classification of the Chrysomelidae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: coleoptera; and family: chrysomelidae.



Figure 19. Chrysomelidae family: (a) Observation results; (b) Comparative images from the literature

The Chrysomelidae family has the following characteristics: relatively small, short, stout, and ovoid, with hard, horn-like forewings (elytra), and the hindwings folded under the forewings when not in use, a biting and chewing mouthpart, short antennae less than half the body length, 11 segments, with the first three segments golden yellow, and varying body color, including black, yellow, orange, or red, often with black spots. Some species have a shiny metallic color. The body consists of a head (caput), thorax, and abdomen. The head does not elongate into a snout, and the tip of the abdomen is usually covered by elytra. Three pairs of legs are present, with the two front pairs being smaller than the hind legs, which are used for jumping (Triplehorn & Johnson, 2005).

Reduviidae Family

General classification of the Reduviidae family according to Triplehorn & Johnson (2005) as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: hemiptera; and family: reduviidae.



Figure 20. Reduviidae family: (a) Observation results; (b) Comparative images from the literature

Assassin bugs (family Reduviidae) are numerous predatory insects belonging to the order Hemiptera and

suborder Heteroptera. Assassin bugs vary greatly in body size and shape, ranging from small to large. Morphologically, Reduviidae are generally dark in color with red and white stripes on the sides, approximately 2.5 cm long, and their beaks emerge from the front of the head, are short, and consist of three parts. The head is not narrowed or divided into lobes and is shorter than the thorax. They have compound eyes. Antennae are as long as or longer than the head, consist of four segments and are visible from above. The forewings are divided into a corium and a membrane, thickened at the base and membranous at the tip (hemelytra) (Triplehorn & Johnson, 2005).

Mantidae Family

General classification of the Mantidae Family according to Triplehorn & Johnson (2005) as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: mantodea; and family: mantidae.

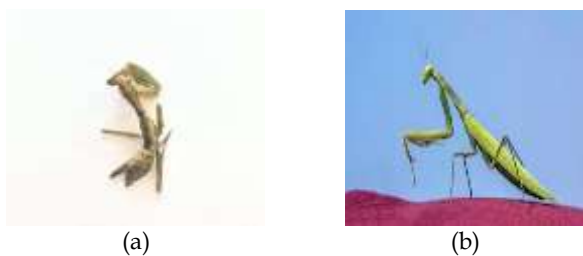


Figure 21. Mantidae family: (a) Observation results; (b) Comparative images from the literature

The Mantidae family has the following characteristics: a slender body shape, varying body length from head to abdomen, a triangular head with high mobility, and prominent compound eyes. The mantis is one of the few insects that can rotate its head. Its forelegs are modified into "raptorial" legs for capturing prey. Its forelegs' resting posture resembles a praying position, hence the name "praying mantis." It has two pairs of wings, with the forelegs being straight and thicker than the hind wings. Its mouthparts are biting and chewing (Triplehorn & Johnson, 2005).



Figure 22. Alydidae family: (a) Observation results; (b) Comparative images from the literature

Alydidae Family

The general classification of the Alydidae family according to Triplehorn & Johnson (2005) is as follows. Kingdom: animalia; phylum: arthropoda; class: insecta; order: hemiptera; and family: alydidae.

The Alydidae family has the following characteristics: Elongated and narrow body shape, compound eyes, has three pairs of long legs, hard, thick, veinless front wings, and membrane-type rear wings that fold when the insect is resting, biting-chewing mouthparts, has a foul odor, the head is slightly wide and almost the same as the pronotum. The stink bug (*Leptocoris varicornis*) is included in the Alydidae family (Triplehorn & Johnson, 2005).

Conclusion

Based on the results of the Inventory of Insect Pests on Food Crops in Lapeom Village, West Insana District, North Central Timor Regency, it can be concluded that there are 8 orders and 22 families of insect pests from 5 observation methods: Pittfal traps, Yellow traps, Sweep nets, Attractants, and Hand-picking and direct observation. The insect pests consist of: the order Blattodea (family Ectobiidae), the order Coleoptera (family Chrysomelidae), the order Diptera (family Tephritidae, family Muscidae, family Bibionidae, family Calliphoridae), the order Hemiptera (family Cicadellidae, family Alydidae), the order Lepidoptera (family Erebididae, family Crambidae), the order Orthoptera (family Gryllidae, family Gryllotalpidae, family Tettigoniidae, and family Tettigoniidae).

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